

Remarks**I. Status**

Claims 1-5 and 10-34 are pending in the application. Claims 1-3, 5, 10-12, and 14-24 have been amended. Claims 25-34 are added. Claims 6-9 have been cancelled.

II. Amendments to the Specification

The title of the invention has been objected to as being allegedly not descriptive. The title has been amended as indicated above.

III. Claim Rejections - 35 U.S.C. § 102

Claims 1-2, 10-11, 13, 18 and 20 have been rejected under 35 U.S.C. 102(e) as being allegedly anticipated by U.S. Patent No. 6,898,669 (Tomita). Claims 1-2, 10-11, 18 and 20 have been amended and the rejection is respectfully traversed.

Embodiments of the invention address a problem associated with identifying valid data on storage devices. Data stored on physical storage devices, such as disk drives, comprise digital information in the form of bits of data. In many cases a storage device comprises not only meaningful data but also unused portions of memory containing bits of data. In some cases the data in unused portions of memory consists of random series of bits, while in other cases such data may contain data from old files that have been deleted, for example. When a storage device is replicated for backup purposes, many current methods simply copy all of the data on the storage device, including any unused data. Because the unused data may comprise a large percentage of the total data copied, these methods can be inefficient. Embodiments of the invention provide a method for identifying valid data on a storage device.

In an example of an embodiment of the invention, files stored on a storage device are identified using a file system which is structured at a file level. The file system therefore contains information identifying one or more files stored on the storage device and their physical addresses. For each file indicated in the file system, a read operation is performed. Each read operation naturally requires an I/O access operation with respect to the storage device. While the files listed in the file system are read, the details of each I/O access operation (including the physical address involved, for example) are recorded. When the entire file system has been processed, the recorded I/O access information is examined and used to generate a list of data blocks containing valid data. The list of valid data may be subsequently used to perform an efficient backup operation.

In accordance with the embodiment described above, amended claim 1 requires “identifying one or more allocated storage locations on the storage device based, at least in part, on a file system associated with the storage device” and “performing a read operation comprising an I/O access with respect to each of the one or more allocated storage locations.” Claim 1 further requires “recording each I/O access performed with respect to the storage device in association with a read operation,” “generating, based on the recorded I/O access information, a list of data blocks on the storage device that contain valid data” and “replicating the data blocks that contain valid data.” Independent claim 10 is a system claim corresponding to claim 1.

Tomita discloses a technique for backing up data. An address translation table is generated and updated as data is written to a disk drive. (Col. 7, lines 49-67). Thus, the translation table contains information indicating the locations of valid data stored on the disk drive. When a backup request is received the translation table is copied to main memory (col. 9, lines 55-64) and used to determine the addresses of valid data on the disk drive. (Col. 10, lines

1-37). The translation table is accessed and each logical address indicated therein is examined to determine whether or not it contains valid data. (Col. 10, lines 24-38). If a logical address contains valid data and has not yet been backed up, the logical address is converted to a physical address (using the table) and the data at that physical address is backed up. (Col. 10, lines 24-37).

Nowhere does Tomita teach or suggest “recording each I/O access performed with respect to the storage device in association with a read operation,” as required by claim 1. As discussed at column 7, lines 49-61, Tomita records physical addresses to the address translation table only when “1-stripe data is *written* to the disk drives.” (emphasis added). Tomita does not record I/O access information in the address translation table, or anywhere else, when *reading* data from the disk drives. None of the other cited references teach or suggest this limitation, either. Therefore, claim 1 and its dependent claims (2-4 and 25-26) and claim 10 and its dependent claims (11-17) are patentable over the cited art. The dependent claims also recite patentable limitations.

Independent method claim 5 requires “causing the storage device to record each I/O access performed with respect to the storage device in association with a read operation.” Similarly, independent claim 18 requires “a first processor configured to: record I/O accesses performed with respect to the storage device in association with read operations.” For the reasons set forth above, Tomita does not teach or suggest these limitations. As such, claim 5 and its dependent claims (27-29), and claim 18 and its dependent claims (19-24) are also patentable over the cited art. The dependent claims also recite patentable limitations.

IV. Claims Rejections - 35 U.S.C. § 103**A. Claims 3, 12 and 21**

Claims 3, 12 and 21 were rejected under 35 U.S.C. 103(a) as being allegedly unpatentable over Tomita in view of U.S. Patent Application No. 2003/0195865 (Long). The rejection is respectfully traversed. Long discloses a technique for performing transaction aware caching of metadata in an electronic file system.

Claim 3 depends from independent claim 1. Claim 12 depends from independent claim 10. Claim 21 depends from independent claim 18. For the reasons set forth above, claims 1, 12 and 18 are patentable over the cited art. Therefore, claims 3, 12 and 21 are also patentable over the cited art. The dependent claims also recite patentable limitations.

B. Claims 4-9, 14-17, 19 and 22-24

Claims 4-9, 14-17, 19 and 22-24 were rejected under 35 U.S.C. 103(a) as being allegedly unpatentable over Tomita in view of U.S. Patent No. 5,668,971 ("Neufeld"). The rejection is respectfully traversed. Claims 6-9 have been cancelled.

Neufeld discloses a method for performing queued or posted disk read operations.

Claim 4 depends from independent claim 1. For the reasons set forth above, claim 1 is patentable over the cited art. Therefore, claim 4 is also patentable over the cited art. Claim 4 also recites a patentable limitation.

As discussed above, amended independent claim 5 requires "causing the storage device to record each I/O access performed with respect to the storage device in association with a read operation." Neither Tomita nor Neufeld teaches or suggests this limitation. Therefore, claim 5 is also patentable over the cited art.

Claims 14-17, as amended, depend from claim 10. For the reasons set forth above, claim 10 is patentable over the cited art. Therefore, claims 14-17 are also patentable over the cited art. The dependent claims also recite patentable limitations.

Claims 19 and 22-24 depend from independent claim 18. For the reasons set forth above, claim 18 is patentable over the cited art. Therefore, claims 19 and 22-24 are also patentable over the cited art. The dependent claims also recite patentable limitations.

V. New Claims 25-34

New claim 25 depends from amended claim 1 and requires that “the file system is structured on a file-level.” Support for new claim 25 is found on page 5, lines 13-19.

New claim 26 depends from amended claim 5 and recites “wherein at least one read operation includes reading metadata associated with one or more files on the storage device.” Support for new claim 26 is found on page 8, lines 9-15.

New claim 27 depends from new claim 26 and further recites “wherein the metadata includes one or more of the following: a name of the file, access permissions to the file, a date of creation of the file, or dates of modification of the file.” Support for new claim 27 is found at page 8, lines 9-15.

New claim 28 depends from amended claim 1 and further requires “storing the list in a memory.” Support for new claim 28 is found at page 9, lines 1-5.

For the reasons set forth above, amended independent claims 1 and 5 are patentable over the cited art. Therefore, new claims 25-28 are also patentable over the cited art by virtue of their dependency on amended claims 1 and 5.

New claim 29 is similar to amended claim 1 but does not contain the limitation, “replicating the data blocks that contain valid data.” No new matter has been added by the

addition of new claim 29. New claim 29 is patentable over the cited art for reasons similar to those set forth above in the discussion of amended claim 1.

New claim 30 depends from new claim 29 and further recites “wherein the file system is associated with a virtual storage device used to manage storage of data on the storage device.”

Support for new claim 30 is found at page 6, lines 6-17.

New claim 31 depends from new claim 29 and further requires “storing the list in a memory.” Support for new claim 31 is found at page 9, lines 1-5.

New independent claim 32 is similar to amended claim 10 but does not contain the limitation, “wherein the first processor replicates the data blocks that contain valid data.” No new matter has been added by the addition of new claim 32. New claim 32 is patentable over the cited art for reasons similar to those set forth above in the discussion of amended claim 10.

New claim 33 depends from new claim 32 and further recites “wherein the file system is associated with a virtual storage device used to manage storage of data on the storage device.”

Support for new claim 30 is found at page 6, lines 6-17.

New claim 34 depends from new claim 32 and further recites “wherein the first processor is further configured to: store the list in a memory.” Support for new claim 34 is found at page 9, lines 1-5.

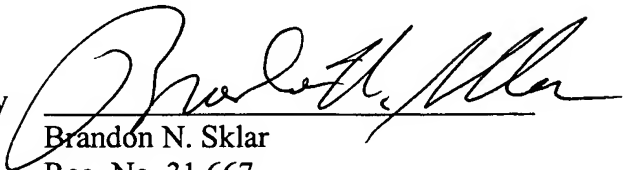
For the reasons discussed above, new independent claim 32 is patentable over the cited art. Therefore, new claims 33-34 are also patentable over the cited art by virtue of their dependency on new claim 32.

No new matter has been introduced in new claims 25-34.

VI. Conclusion

In view of the foregoing, each of claims 1-5 and 10-34, as amended, is believed to be in condition for allowance. Accordingly, reconsideration of these claims is requested and allowance of the application is earnestly solicited.

Respectfully submitted,
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